

Fishery Data Series No. 91-54

Cook Inlet Rainbow Trout Studies 1990

by

Terry J. Bradley

October 1991

Alaska Department of Fish and Game

Division of Sport Fish



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¹ This information was partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K) under Project F-10-6, Job No. R-2-6.

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TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES.....	ii
LIST OF FIGURES.....	iv
LIST OF APPENDICES.....	v
ABSTRACT.....	1
INTRODUCTION.....	2
METHODS.....	3
Age and Length of Rainbow Trout.....	3
Study Design.....	3
Data Collection.....	5
Data Analysis.....	6
Creel Surveys.....	7
Study Design.....	7
Data Collection.....	9
Data Analysis.....	9
RESULTS.....	16
Age and Length Statistics.....	16
Sampling.....	16
Age Composition.....	16
Mean Length-at-Age.....	21
Length Distributions.....	21
Creel Estimates.....	29
Effort.....	29
Harvest and Catch.....	29
Miscellaneous Statistics.....	29
DISCUSSION.....	37
ACKNOWLEDGEMENTS.....	39
LITERATURE CITED.....	39
APPENDIX A.....	41

LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. Summary of trap data by various capture methods for rainbow trout in Lake Creek, Deshka River, and the Talachulitna River, 1990.....	17
2. Age composition of rainbow trout by gear type and in the sport harvest in Lake Creek, 1990.....	18
3. Age composition of rainbow trout by gear type in the Deshka River, 1990.....	19
4. Age composition of rainbow trout by gear type in the Talachulitna River, 1990.....	20
5. Mean fork length in millimeters by age group of rainbow trout by capture methods and in the sport harvest in Lake Creek, 1990.....	22
6. Mean fork length in millimeters by age group of rainbow trout by capture methods in the Deshka River, 1990.....	23
7. Mean fork length in millimeters by age group of rainbow trout by capture methods in the Talachulitna River, 1990.....	24
8. Summary of sample data for catch, harvest, and effort for anglers interviewed during the rainbow trout creel survey at Lake Creek, 1990.....	30
9. Estimated effort, catch, and harvest for the Lake Creek rainbow trout creel survey, 1990.....	31
10. Estimated effort by zone for the Lake Creek rainbow trout creel survey, 1990.....	32
11. Composition of anglers with one or more rainbow trout and anglers with no rainbow trout for complete/incomplete and guided/unguided angler interviews during the rainbow trout creel survey at Lake Creek, 1990.....	33
12. Opinions from interviewed angler trips during the creel survey for rainbow trout at Lake Creek, 1990.....	34

LIST OF TABLES (Continued)

<u>Table</u>	<u>Page</u>
13. Composition of interviewed angler trips by zone using bait, lures, or both bait and lures during the rainbow trout creel survey at Lake Creek, 1990.....	36
14. Composition of guided and unguided anglers in interviewed angler trips during the rainbow trout creel survey at Lake Creek, 1990.....	38

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1. Map of the Cook Inlet rainbow trout study area.....	4
2. Map of the lower Lake Creek area.....	8
3. Length frequency distributions by gear type of rainbow trout captured in Lake Creek, 1990.....	25
4. Length frequency distribution of rainbow trout captured with hoop traps and hook and line (ADFG) in Lake Creek, 1990.....	26
5. Length frequency distribution of rainbow trout captured by hoop traps in the Deshka River, 1990.....	27
6. Length frequency distributions of rainbow trout captured in the Talachulitna River by gear type, 1990..	28

LIST OF APPENDICES

<u>Appendix</u>	<u>Page</u>
A1. Daily statistics by period for the Lake Creek rainbow trout creel survey, 1990.....	42
A2. Daily statistics for effort, catch, and harvest for the Lake Creek rainbow trout creel survey, 1990.....	44
A3. Daily statistics for effort by period and zone for the Lake Creek rainbow trout creel survey, 1990....	45
A4. Daily statistics for effort by zone for the Lake Creek rainbow trout creel survey, 1990.....	47

ABSTRACT

A total of 1,289 rainbow trout *Oncorhynchus mykiss* were captured by hoop traps, minnow traps, and hook and line from Lake Creek, Deshka River, and the Talachulitna River in 1990. Age composition and mean length-at-age varied by river and gear type. Age composition of rainbow trout taken at Lake Creek by hoop traps and hook and line were not significantly different. Age composition of rainbow trout taken from the Talachulitna River by hoop traps and hook and line were significantly different. There were significant interactions between length-at-age and gear type among the hoop trap, hook and line, and creel survey samples at Lake Creek. Rainbow trout sampled from the three rivers ranged from 71 mm to 571 mm in fork length. At Lake Creek, the length frequency comparison was significantly different when comparing hoop traps, hook and line, and creel survey, but was not significantly different when comparing hoop traps and hook and line. There was an insufficient number of hook and line samples at the Deshka River to do a length frequency comparison between gear types. The length frequency comparison between hoop traps and hook and line was significantly different at the Talachulitna River.

Roving creel surveys were conducted at Lake Creek to estimate effort for and catch and harvest of rainbow trout in the sport fishery from 12 August through 9 September 1990. An estimated 2,841 angler-hours of effort (standard error = 322) resulted in the catch (fish kept plus fish released) of 1,457 rainbow trout (standard error = 213). An estimated 139 rainbow trout (standard error = 4) were harvested (fish kept only) during the survey. In an opinion poll, the majority of responding anglers in zone 1 and 2 (area of Lake Creek not closed to the harvesting of rainbow trout) favored mandatory release of rainbow trout and the use of artificial lures. Guided anglers accounted for approximately 90% of the effort during the creel survey.

KEY WORDS: rainbow trout, *Oncorhynchus mykiss*, age composition, mean length-at-age, length frequency comparison, Lake Creek, Deshka River, Talachulitna River, hoop traps, minnow traps, hook and line, creel survey, effort, catch, harvest.

INTRODUCTION

Use of special regulations which set size and bag limits and restrict terminal tackle to artificial lures is increasing on trout waters in Alaska. This regulatory tendency reflects a growing concern among sport anglers that larger and older rainbow trout *Oncorhynchus mykiss* are, or will be, over-exploited and that the quality of fishing is declining at many popular rainbow trout streams. Unfortunately, the Alaska Department of Fish and Game (ADFG) cannot respond adequately to these concerns because of an insufficient wild rainbow trout data base.

Implementation of special regulations has occurred in almost all waters without a thorough awareness of existing exploitation rates and with little knowledge of what constitutes an allowable rate of sustained harvest. A comprehensive wild rainbow trout study has never been conducted by ADFG within the Susitna River basin. Present management of wild rainbow trout depends almost solely on harvest trends developed by the Alaska Sport Fish Harvest Survey (Mills 1990). Essential information such as harvest rates, size and age structure of harvest, location and seasonal nature of harvest, plus the biological characteristics of the various rainbow trout populations is currently lacking for almost all Susitna River basin rainbow trout. Age and size composition, longevity, recruitment rates, and many other essential biological considerations are likewise poorly understood or completely lacking for many rainbow trout populations that have been targeted for special regulations.

A comprehensive evaluation of the effectiveness of special regulations requires assessment of both the fishery and fish population before and after application of special regulations. Such evaluations have seldom been performed on Alaskan rainbow trout fisheries. Continued application of special regulations without evaluation may hinder rather than enhance achievement of optimum sustained human benefits from Cook Inlet rainbow trout stocks.

The inability to define sustained harvest has catalyzed the angling public to request restrictive regulations that many hope will yield improved fishing or at the very least will protect the resource until definitive management information becomes available. Deluged with such requests, the Alaska Board of Fisheries has in recent years: (1) reduced the daily bag limit for Cook Inlet from 10 to five fish; (2) reduced the daily limit in most Susitna Basin streams to two rainbow trout; (3) designated four Susitna Basin streams or portions of streams as hook and release waters for rainbow trout (Talachulitna River, Lake Creek upstream from an ADFG marker 1/4 mi upstream from Bulchitna Lake, Moose and Kroto creeks above the forks in the Deshka River drainage, and Fish Creek, a tributary of Clear Creek); (4) required only single-hook lures or artificial lures in most flowing waters at specific times; and (5) closed certain streams or stream sections during specific seasonal times.

Nearly all of these special regulations were adopted with little documented data regarding the status of the affected rainbow trout populations. Both the Alaska Board of Fisheries and ADFG recognized that many of these special provisions may not be optimal rainbow trout management in the classical

sense, but none of the special regulations are expected to have detrimental effects on the resource. The Board of Fisheries and ADFG further acknowledge that reducing the rainbow trout harvest needlessly may not be a good practice as far as providing maximum fishing opportunities is concerned, but a conservative regulatory approach is warranted because of the scarcity of stock status data.

It is clearly recognized by ADFG that there is a serious need for new management approaches dealing with Alaska's wild rainbow trout fisheries. As the number of fishermen increases, the quality of rainbow trout fishing can be expected to decrease. Protective fishing regulations will become increasingly necessary to reduce angler induced mortality, and recycling of the catch will likely become a dominant consideration for some fisheries.

If Alaska is to maintain quality wild rainbow trout fishing, it is essential that ADFG support regulations that are commensurate with the capabilities of the resource and that these regulations are compatible with the diversified desires of the angling public. The Department cannot presently meet this obligation because of a poor knowledge of Susitna River basin rainbow trout and their supporting environments. This investigation is viewed as a first phase effort to acquire needed data relative to the biology of Susitna Basin rainbow trout and the harvest of these stocks.

The Cook Inlet rainbow trout project has three major components that focus on Susitna Basin rainbow trout stocks. The objectives of this report are to present:

1. estimates of the age and length composition by gear-type for rainbow trout at Lake Creek, Deshka River, and the Talachulitna River;
2. estimates of fishing effort for and the catch and harvest of rainbow trout at Lake Creek during the fall; and
3. estimates of the age and length composition of rainbow trout harvested from the lower reaches of Lake Creek during the period August through mid-September.

METHODS

Age and Length of Rainbow Trout

Study Design:

The sampling of rainbow trout for age-length data was conducted at Lake Creek, Deshka River, and the Talachulitna River (Figure 1). Sampling began 24 July and continued until 10 October 1990. The selection of study reaches depended on the ability to deploy gear.

Hook and line and hoop traps were used to sample adult (over 150 mm) rainbow trout. These gear types were used most successfully during the 1989

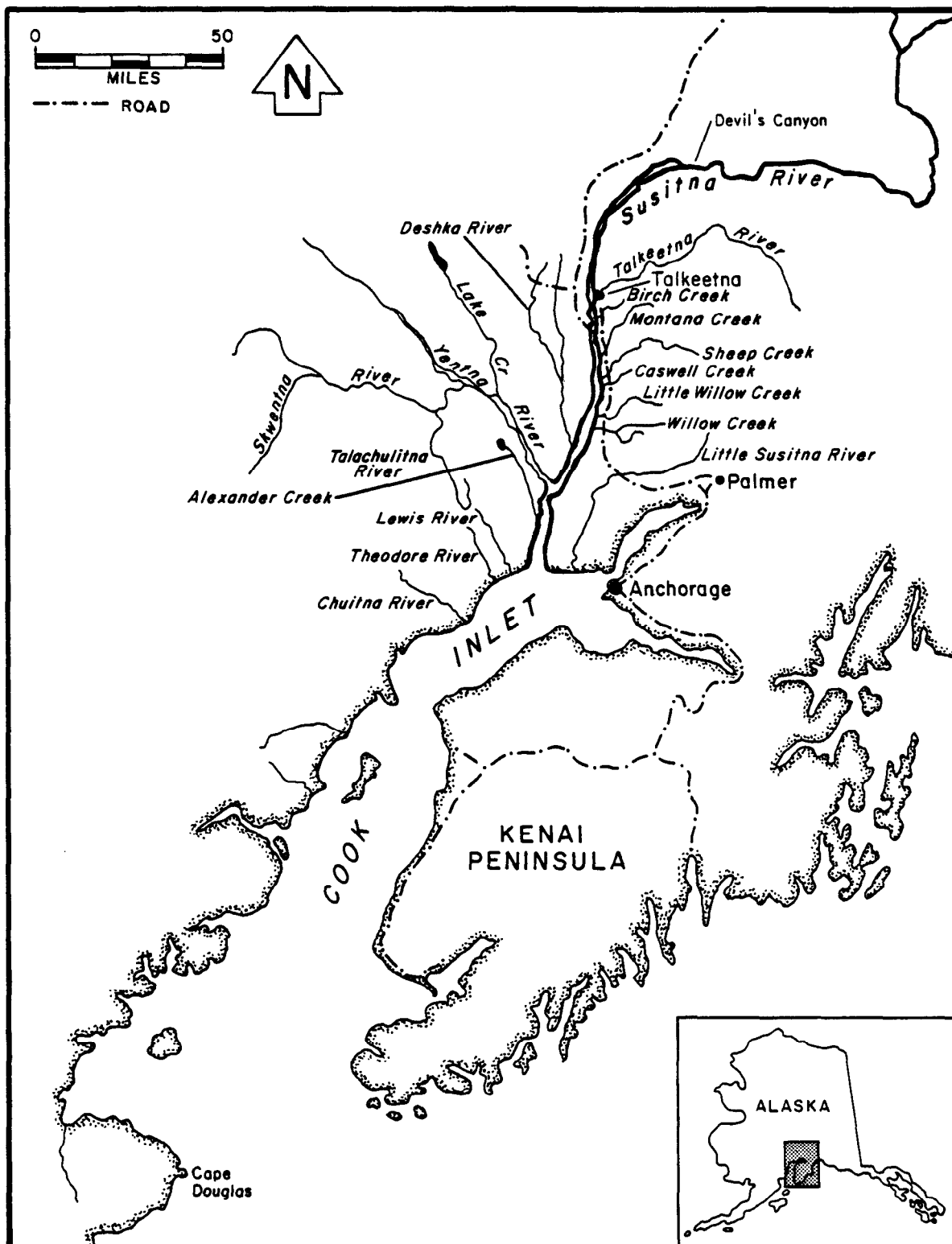


Figure 1. Map of the Cook Inlet rainbow trout study area.

sampling. As these gear types are known to be size-selective (Bradley 1990) the sampling was stratified by gear.

Minnow traps were used to sample juvenile rainbow trout (under 150 mm), which are not recruited to the hoop traps or the hook and line gear.

Data Collection:

Lake Creek was sampled from the confluence with the Yentna River upstream approximately 5.6 km (3.5 mi). The Deshka River was sampled from the confluence of the Susitna River upstream approximately 32 km (20 mi) to Neil Lake, and Moose Creek, a tributary of the Deshka River, was sampled from the south end of the Oilwell Road upstream approximately 13 km (8 mi) to the Petersville Road. The Talachulitna River was sampled from the confluence of the Skwentna River upstream approximately 3.2 km (2 mi). These selected areas were sampled with hoop traps, hook and line, and minnow traps. The hoop traps and minnow traps were serviced (i.e., fish removed) at least every 24 hours. All traps were baited with salmon roe held in perforated plastic containers. Trap entrances were positioned parallel to the stream flow.

Hook and line fishing was conducted with conventional spin and fly casting equipment. Terminal gear consisted of artificial lures and/or salmon roe as bait. Hoop traps were 2.4 m (8 ft) in length, 61 cm (24 in) in diameter, and were supported by seven steel or aluminum hoops. The 10.2 cm (4 in) internal throats and body were constructed of 2.5 cm (1 in) square knotted nylon mesh dyed black. Two pieces of 1.3 cm (0.5 in) pipe were used to keep the hoop trap rigid. Minnow traps, consisting of 0.6 cm (0.25 in) wire mesh, were 45.7 cm (18 in) in length and 22.9 cm (9 in) in diameter. All minnow traps were of a two piece-double funnel entrance design.

Sampled stream reaches were identified and numbered on USGS maps (scale 1:250,000). Stream reach identification numbers were entered on all data collection forms. The beginning and ending times for all hook and line sampling were recorded for each angler during periods of active fishing. The type of terminal gear was also recorded. The number of fish caught by species was recorded per unit of fishing effort. Data from captured rainbow trout consisted of fork length measurements (to nearest millimeter) and three scales from the left side of each fish about two rows above the lateral line and on a diagonal row downward from the posterior insertion of the dorsal fin (Clutter and Whitesel 1956). Scales were placed in coin envelopes that were labeled with appropriate identification information.

The beginning and ending times, as well as trap number, were recorded for each hoop and minnow trap set. The catch from all traps was emptied into a tub containing water where the fish were identified by species, counted, and returned to the stream. Fish were anesthetized with equal parts of MS-222 and Quinate. Rainbow trout length measurements and scales were collected as described above.

Scale collection goals for each of the three study streams were 300 sets from rainbow trout larger than 150 mm fork length; 150 for each gear type. Another 150 scales were to be collected from juvenile (less than 150 mm) rainbow trout for assessment of early scale pattern development.

Trap set identification numbers, sample location numbers, beginning and ending set times, and the numbers of fish caught by species were initially recorded on handwritten forms. Later, these data were transferred onto mark-sense forms. Data from hook and line sampling were similarly recorded and then later transferred to mark-sense forms.

Fish length data from each sample unit (hoop traps, minnow traps, and hook and line) were recorded on individual mark-sense forms. Scales were cleaned and placed between two glass slides for aging. A Northwest 77 microfilm projector was used to age the rainbow trout scales. Trout age data were recorded on AWL mark-sense forms.

Data Analysis:

Mean catch rates (catch per hour fished) for each gear type were estimated for each study stream.

The proportion in each age class was estimated for each gear by:

$$\hat{p}_{ij} = \frac{n_{ij}}{n_j}, \quad (1)$$

where:

\hat{p}_{ij} = estimated proportion in age class i for gear type j ,

n_{ij} = number sampled in age class i for gear type j ,

n_j = total number sampled in gear type j ,

and the variance of \hat{p}_i was estimated by:

$$\text{Var}(\hat{p}_{ij}) = \frac{\hat{p}_{ij}(1-\hat{p}_{ij})}{n_j-1}. \quad (2)$$

Mean lengths-at-age with associated variances were estimated for trout from each stream using standard normal statistical procedures (Sokal and Rohlf 1981). Note that length and age information from all fish sampled in each stream by a gear type were given equal weights (that is, the data were treated as a simple random sample), although sampling intensity varied throughout the length of each stream and between days. This treatment requires the assumption that length and age distributions do not vary throughout the area sampled in each stream, nor do they vary across time.

The age and length distributions of the samples from each gear type within a system were compared in order to determine the size selectivity of the gear types. Length distributions were compared between gear types using a nonparametric K-sample Anderson-Darling test (Scholz and Stephens 1987). Age compositions were compared using chi-square statistics. The mean length-at-age was compared among gear-types using 2-factor ANOVA models which tested

for interaction between gear and age (Snedecor and Cochran 1967). All tests were carried out at an alpha level of 0.05.

Creel Surveys

Study Design:

Roving creel surveys (Neuhold and Lu 1957) were conducted to estimate effort, catch, and harvest of rainbow trout by anglers fishing the lower reaches of Lake Creek during the fall. The entire drainage of Lake Creek was open to fishing for rainbow trout from 1 January to 31 December 1990. The area upstream of a Department of Fish and Game marker 0.4 km (0.25 mi) upstream of Bulchitna Lake is a catch and release only area for rainbow trout. Only unbaited artificial lures may be used in this area. After 1 September, the area downstream of the marker is also restricted to unbaited artificial lures.

Physical barriers within the river restrict the majority of the anglers to the lower 4.0 km (2.5 mi) of the river. Primary access by anglers to this fishery is floatplane, wheel plane, and riverboat. Some fishing for rainbow trout is recognized to occur upstream of the creel survey area, however, this fishing effort is considered small relative to effort within the surveyed stream reach.

A stratified random sample design was used for angler counts within the study area. The fishing day was defined to be 16 hours long (0600 to 2200 hours) from 12 August through 26 August. Starting 27 August and continuing through 9 September the fishing day was shortened to 14 hours (0600 to 2000 hours) because of reduced daylight. The survey was stratified by weekdays and weekend/holidays. Three randomly selected weekdays (without replacement) and all weekend/holidays were surveyed. The day was divided into five equal sample periods. These were 3 hours and 12 minutes from 12 to 26 August and 2 hours and 48 minutes from 27 August to 9 September. On each day sampled, two of these periods were randomly selected for sampling. During a sample period, two counts, systematically chosen, were performed. Counts were performed from a riverboat traveling the 4.8 km (3 mi) length of the survey area and took about 30 minutes to complete. A coin toss determined if a count occurred in an upstream or downstream direction. Each angler count was further segregated into three stream zones (Figure 2) including:

Zone 1 - confluence of Lake Creek/Yentna River;

Zone 2 - confluence (Zone 1) upstream to regulatory markers about 0.4 km (0.25 mi) upstream from Bulchitna Lake; and

Zone 3 - upstream from Zone 2 to end of survey area. This is the catch and release area.

Angler interviews were performed during the time that a count was not being conducted. Interviews were conducted throughout the length of the survey area i.e. interviews in all river zones. The creel survey did not start in zone 1 until 25 August because of the coho salmon *Oncorhynchus kisutch* fishery at the confluence and the absence of rainbow trout anglers. During

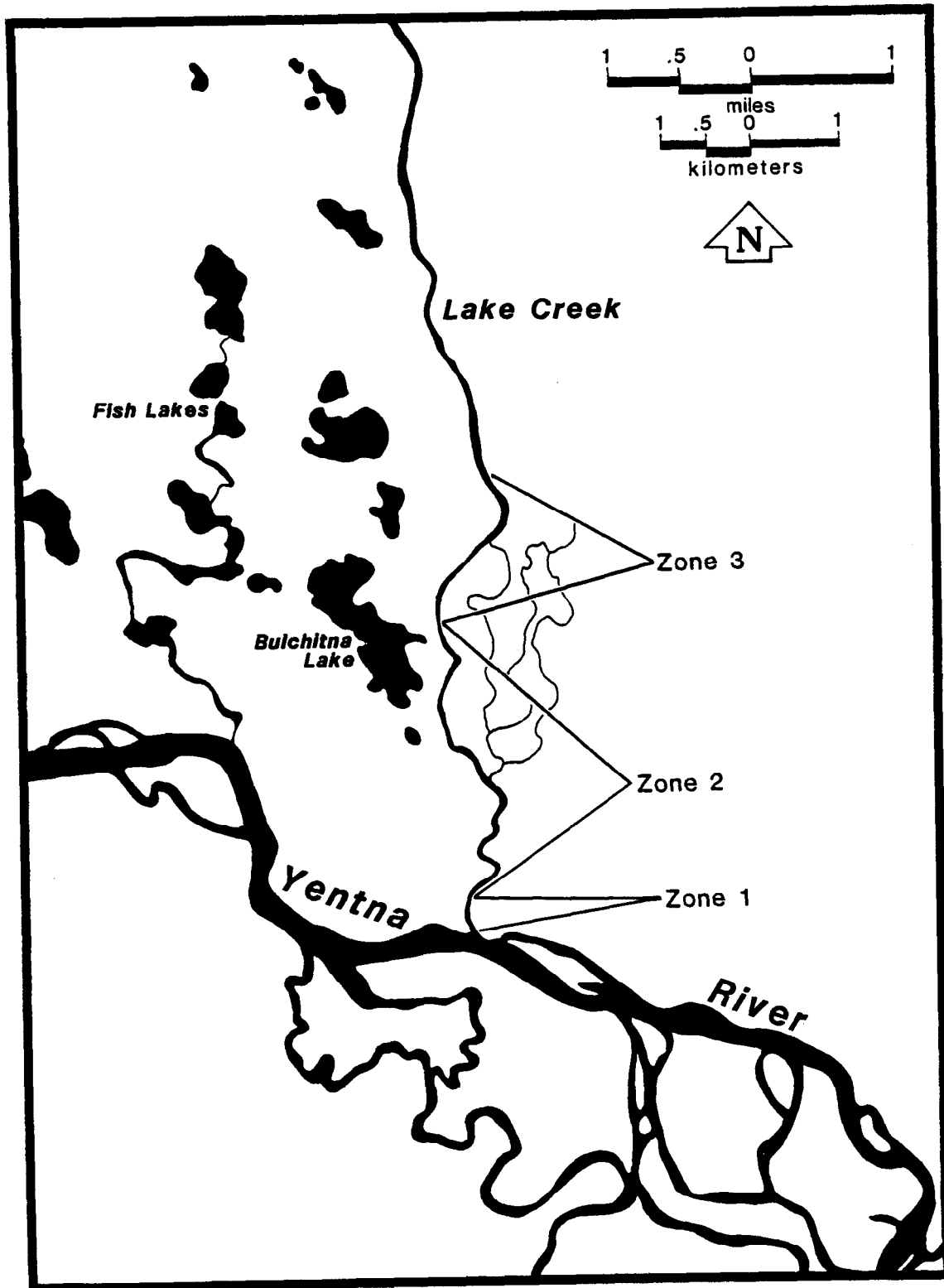


Figure 2. Map of the lower Lake Creek area.

periods of heavy fishing effort, when it was not possible to interview all anglers in the survey area, special attention was given to obtaining representative interviews within each zone.

Data Collection:

Survey personnel used mark-sense forms to record angler counts, angler interview data, and biological information from harvested fish.

The following information was recorded during all angler interviews:

1. the number of hours spent fishing;
2. whether the angler had completed the fishing trip or not;
3. whether the angler was guided or unguided;
4. the number and species of fish harvested (kept);
5. the number and species of fish released;
6. the species of fish targeted;
7. whether the angler used bait, lures, or both; and
8. the river zone where effort occurred.

In addition, the following questions were asked all anglers:

1. Most of the Lake Creek drainage is now governed by regulations that require or promote the release of rainbow trout.
 - a. Should these artificial lure/no kill trout requirements be expanded, eliminated, or left as is within the Lake Creek drainage?
 - b. Do you favor, oppose, or have no opinion on requiring mandatory release of rainbow trout at other Susitna Basin waters?
2. The use of unbaited artificial lures is now required on the lower 4.0 km (2.5 mi) of Lake Creek after 1 September.
 - a. Do you favor, oppose, or have no opinion on this artificial lure requirement?
 - b. Should this artificial lure requirement start earlier in the season, start later in the season, or be left as is?

A portion of the harvested rainbow trout was sampled for length and scales. Length and scales were collected as described earlier in this report and identified by river zone in which the trout were harvested.

Data Analysis:

Angler effort, catch, and harvest, their associated variances, and standard errors were estimated for the creel survey using the following procedures. A systematic-random estimator was used to estimate angler effort on a sample-by-sample basis. Catch and harvest estimates for each sample were obtained by a ratio estimator: by combining the estimated effort (for the sample)

with estimates of catch per unit effort (CPUE) and harvest per unit effort (HPUE) obtained from angler interviews. The CPUE and HPUE estimates were obtained by the jackknife estimation approach (Efron 1982).

The individual sample estimates of effort, catch, and harvest were used in a stratified three-stage approach to obtain total estimates, both within strata and across strata.

The first step involved obtaining the jackknife estimated sample mean of CPUE (or HPUE) as follows:

$$\begin{aligned}
 & \text{CPUE}_{hijk}^* = \text{the jackknifed CPUE for angler } k \text{ in sample } j \text{ within day } i \text{ and stratum } h; \\
 & = \frac{\sum_{\substack{o=1 \\ o \neq k}}^{m_{hij}} c_{hijo}}{\sum_{\substack{o=1 \\ o \neq k}}^{m_{hij}} e_{hijo}}; \quad (3)
 \end{aligned}$$

where m_{hij} equals the number of anglers interviewed within each sampled period during each sampled day; and c_{hijo} and e_{hijo} equal the catch and angling effort in hours of each angler interviewed.

The jackknife mean CPUE for sample j within day i and stratum h was then obtained as:

$$\overline{\text{CPUE}_{hij}}^* = \frac{\sum_{k=1}^{m_{hij}} \text{CPUE}_{hijk}^*}{m_{hij}}. \quad (4)$$

Then the bias correction (adapted from Efron 1982, equation 2.8, page 6) was performed:

$$\overline{\text{CPUE}_{hij}}^{*\dagger} = [m_{hij} (\overline{\text{CPUE}_{hij}}^* - \overline{\text{CPUE}_{hij}}^*)] + [\overline{\text{CPUE}_{hij}}^*]; \quad (5)$$

where:

$$\overline{\text{CPUE}_{hij}} = \frac{\sum_{k=1}^{m_{hij}} c_{hijk}}{\sum_{k=1}^{m_{hij}} e_{hijk}}. \quad (6)$$

If the bias correction resulted in a negative value, then the uncorrected version (equation 4) was used in all subsequent calculations.

The bias-corrected jackknife mean was then expanded by the estimated angler effort for the sample to obtain the estimated catch for each sample:

$$\hat{C}_{hij} = \hat{E}_{hij} \overline{CPUE}_{hij}^* \quad (7)$$

where:

$$\begin{aligned} \hat{E}_{hij} &= \text{estimated angler effort (in hours) for each sample;} \\ &= H_{hij} \bar{x}_{hij}; \end{aligned} \quad (8)$$

$$\begin{aligned} \bar{x}_{hij} &= \text{mean angler count for each sample;} \\ &= \frac{\sum_{q=1}^{r_{hij}} x_{hijq}}{r_{hij}}; \end{aligned} \quad (9)$$

H_{hij} equals the number of hours in sampling period j within day i and stratum h ; x_{hijq} is the number of anglers counted during each count sample within each period; and r_{hij} is the number of counts made within each period.

The harvest for the sample was estimated similarly by substituting the appropriate harvest statistics into equations 2 to 7, above.

Estimates of angler effort, catch, and harvest for each day sampled were obtained as follows:

$$\begin{aligned} \bar{\hat{Y}}_{hi} &= \text{mean of the sample estimates each sampled day within each stratum; in which } Y \text{ represents } E, C, \text{ or } H \text{ for effort, catch, and harvest, respectively;} \\ &= \frac{\sum_{j=1}^{Phi} \hat{Y}_{hij}}{Phi}; \end{aligned} \quad (10)$$

where:

$$\begin{aligned} Phi &= \text{number of periods sampled within day } i \text{ and stratum } h; \text{ and} \\ \hat{Y}_{hij} &= \text{estimated sample value for effort (E, as obtained from equation 8, above), catch or harvest (C or H, as obtained from equation 7, above).} \end{aligned}$$

The estimated daily effort, catch, and harvest were obtained by expanding by the number of sampling periods in the day:

$$\begin{aligned}\hat{Y}_{hi} &= \text{estimate for day } i \text{ within stratum } h; \text{ in which } Y \text{ represents} \\ &\quad E, C, \text{ or } H \text{ for effort, catch, and harvest, respectively;} \\ &= \bar{P}_{hi} \bar{Y}_{hi};\end{aligned}\tag{11}$$

where:

$$\bar{P}_{hi} = \text{number of possible sampling periods within day } i \text{ and stratum } h.$$

Similarly, we obtained estimates for each sampling stratum as follows:

$$\begin{aligned}\bar{\hat{Y}}_h &= \text{mean of the daily estimates for stratum } h; \text{ in which } Y \\ &\quad \text{represents } E, C, \text{ or } H \text{ for effort, catch, and harvest,} \\ &\quad \text{respectively;} \\ &= \frac{\sum_{i=1}^{d_h} \hat{Y}_{hi}}{d_h};\end{aligned}\tag{12}$$

where:

$$d_h = \text{number of days sampled within stratum } h.$$

The estimated stratum effort, catch, and harvest were obtained by expanding by the number of days in each stratum:

$$\begin{aligned}\hat{Y}_h &= \text{estimate for stratum } h; \text{ in which } Y \text{ represents } E, C, \text{ or } H \\ &\quad \text{for effort, catch, and harvest, respectively;} \\ &= \bar{D}_h \bar{\hat{Y}}_h;\end{aligned}\tag{13}$$

where:

$$\bar{D}_h = \text{number of days within stratum } h.$$

The variance of the estimated catch for each stratum was obtained by the three-stage variance equation (following the approach outlined by Cochran 1977), omitting the finite population correction factor (FPC) for the third stage units:

$$\begin{aligned}
\hat{V}[\hat{C}_h] = & \left\{ (1 - f_{1h}) D_h^2 \frac{S_{1h}^2}{d_h} \right\} \\
& + \left\{ f_{1h} D_h^2 \sum_{i=1}^{d_h} (1 - f_{2hi}) P_{hi}^2 \frac{S_{2hi}^2}{d_h^2 P_{hi}} \right\} \\
& + \left\{ f_{1h} D_h^2 \sum_{i=1}^{d_h} f_{2hi} P_{hi}^2 \sum_{j=1}^{P_{hi}} \frac{\hat{V}[\hat{C}_{hij}]}{d_h^2 P_{hi}^2} \right\} ;
\end{aligned} \tag{14}$$

where:

$$\begin{aligned}
f_{1h} &= \text{sampling fraction for days;} \\
&= \frac{d_h}{D_h}
\end{aligned} \tag{15}$$

$$\begin{aligned}
S_{1h}^2 &= \text{the among day variance for the total angler catch estimate over all days sampled in stratum h;} \\
&= \frac{\sum_{i=1}^{d_h} (\hat{C}_{hi} - \bar{\hat{C}}_h)^2}{d_h - 1};
\end{aligned} \tag{16}$$

$$\begin{aligned}
f_{2hi} &= \text{sampling fraction for periods within each day;} \\
&= \frac{P_{hi}}{P_{hi}}
\end{aligned} \tag{17}$$

$$\begin{aligned}
S_{2hi}^2 &= \text{the among period variance for day i in stratum h;} \\
&= \frac{\sum_{j=1}^{P_{hi}} (\hat{C}_{hij} - \bar{\hat{C}}_{hi})^2}{P_{hi} - 1};
\end{aligned} \tag{18}$$

$$\hat{V}[\hat{C}_{hij}] = \text{the within period variance for the estimated sample catch for sample j within day i and stratum h, obtained by Goodman's (1960) formula for the variance of a product of independent random variates:}$$

$$= \hat{E}_{hij}^2 s_{3hij}^2 + (\overline{CPUE}_{hij})^2 \hat{V}[E_{hij}] - s_{3hij}^2 \hat{V}[E_{hij}]; \quad (19)$$

s_{3hij}^2 = jackknife estimate of the variance for the jackknifed sample mean CPUE for sample j within day i and stratum h (adapted from Efron 1982, equation 3.2, page 13);

$$= \frac{(m_{hij} - 1)}{m_{hij}} \sum_{k=1}^{m_{hij}} (CPUE_{hijk} - \overline{CPUE}_{hij})^2; \quad (20)$$

$\hat{V}[E_{hij}]$ = estimated variance of the angler effort estimate for sample j within day i and stratum h, obtained by using the successive differences formula appropriate for systematic samples (adapted from Wolter 1985, equation 7.2.4, page 251);

$$= \frac{H_{hij}^2}{r_{hij}} \frac{\sum_{q=2}^{r_{hij}} \left\{ x_{hijq} - x_{hij(q-1)} \right\}^2}{2 (r_{hij} - 1)}. \quad (21)$$

Variance estimates for the estimated harvest were obtained by replacing the appropriate harvest statistics (h's and H's) for the catch statistics (c's and C's) in equations 14 through 20, above.

Stratum estimates of the variance of the angler effort were obtained in a similar manner to those for catch and harvest. The primary difference occurs in the third major term in equation 14:

$$\begin{aligned} \hat{V}[E_h] = & \left\{ (1 - f_{1h})^2 D_h \frac{S_{1h}^2}{d_h} \right\} \\ & + \left\{ f_{1h}^2 D_h \sum_{i=1}^{d_h} (1 - f_{2hi})^2 P_{hi} \frac{S_{2hi}^2}{d_h^2 P_{hi}} \right\} \\ & + \left\{ f_{1h}^2 D_h \sum_{i=1}^{d_h} f_{2hi}^2 P_{hi} \sum_{j=1}^{P_{hi}} \frac{\hat{V}[E_{hij}]}{d_h^2 P_{hi}^2} \right\}. \end{aligned} \quad (22)$$

The values for the terms in equation 22 were obtained by replacing the catch statistics (C's) by the appropriate effort statistics (E's), in equations 15 through 18, and equation 21 was used as is in the final term of equation 22.

Total angler effort, catch, or harvest across all strata and the associated variances were calculated by summing statistics across temporal components, and the standard errors obtained by taking the square root of the associated variances.

Relative precisions of the 95% confidence interval (RP) for the estimates of effort, catch, and harvest were estimated by:

$$RP = \left[\frac{1.96 \{ (\hat{V}[\hat{Y}_h])^{1/2} \}}{\hat{Y}_h} \right] 100 , \quad (23)$$

where:

\hat{Y}_h = estimate for the parameter of interest in stratum h, and

$\hat{V}[\hat{Y}_h]$ = variance estimate for the estimated total for the parameter of interest.

For the effort, catch, and harvest estimates to be unbiased, the following assumptions were necessary:

1. there was no significant fishing effort or catch taking place during times outside of the defined fishing day,
2. anglers accurately reported their hours of fishing effort and the number of rainbow trout released,
3. anglers were interviewed in proportion to their abundance in each sampling period, and interviewed anglers were representative of the total angler population, and
4. harvest, catch, and effort by individual anglers were normally distributed random variables (this assumption was necessary for the 95% confidence intervals to be unbiased).

Angler's responses to the questions concerning regulations were combined across all strata, and the percent of each response type determined with each interviewed angler-trip weighted equally. The same approach was used to determine the percent of guided and unguided anglers and the percent of anglers using each gear type in the fishery. Note that this method assumes that anglers are sampled in proportion to their abundance or that these angler characteristics do not vary among strata.

RESULTS

Age and Length Statistics

During 1990, 1,289 rainbow trout were sampled by hoop trap, hook and line, and minnow trap in Lake Creek, Deshka River, and the Talachulitna River. Of these, 612 were sampled in Lake Creek, 247 were sampled in the Deshka River, and 430 were sampled in the Talachulitna River (Table 1).

Sampling:

At Lake Creek, a total of 456 rainbow trout were sampled by hoop traps, 20 rainbow trout were sampled by minnow traps, and 136 rainbow trout were sampled by hook and line. Hook and line samples include those caught by ADFG anglers and, in some cases, also those collected from anglers interviewed during the creel survey (Table 1). At the Deshka River, a total of 240 rainbow trout were sampled by hoop traps, no rainbow trout were sampled by minnow traps, and 7 rainbow trout were sampled by hook and line. At the Talachulitna River, a total of 249 rainbow trout were sampled by hoop traps, 4 rainbow trout were sampled by minnow traps, and 177 rainbow trout were sampled by hook and line.

Age Composition:

Rainbow trout sampled from Lake Creek and the Talachulitna River ranged from age class 1 through age class 7. All the age class 1 fish were captured by minnow traps. Age classes 2 through 5 comprised the largest percentage of rainbow trout sampled in both Lake Creek and the Talachulitna River with few age class 7 fish being captured. The dominant age classes of rainbow trout sampled in the Deshka River were age class 2 through 4 with age class 6 being the oldest rainbow trout sampled (Tables 2, 3, and 4).

Age compositions of rainbow trout taken from Lake Creek by hoop traps and hook and line (fish caught by ADFG employees) were not significantly different ($\chi^2 = 5.44$, $df = 5$, $0.25 < p < 0.10$) (Table 2). Eighty-seven percent ($SE = 2$) of the hoop trap samples were from age class 2, 3, and 4 while 83% ($SE = 4$) of the hook and line samples (ADFG) were from age class 2, 3, and 4. The creel survey samples had a higher proportion of age class 5, 6, and 7 rainbow trout than either the hoop traps ($\chi^2 = 99.44$, $df = 1$, $p < 0.001$) or hook and line (ADFG) ($\chi^2 = 9.77$, $df = 1$, $0.001 < p < 0.005$) samples.

Eighty-seven percent ($SE = 2$) of the rainbow trout sampled in the Deshka River by hoop traps were from age class 2, 3, and 4 (Table 3).

Age composition of rainbow trout taken from the Talachulitna River by hoop traps and hook and line were significantly different ($\chi^2 = 44.78$, $df = 5$, $p < 0.001$) (Table 4). Eighty-seven percent of the rainbow trout sampled by hoop traps were age class 2, 3, and 4 ($SE = 2$), whereas age class 3, 4, and 5 comprised 81% ($SE = 4$) of the hook and line sample.

Table 1. Summary of trap data by various capture methods for rainbow trout in Lake Creek, Deshka River, and the Talachulitna River, 1990.

Gear Type	Lake Creek		Deshka River		Talachulitna River	
	Hours Fished	Number caught	Hours Fished	Number caught	Hours Fished	Number caught
Hoop Trap	448	456	1592	240	496	249
Minnow Trap	312	20	1616	0	528	4
Hook & Line	74 ^a	88 ^a	47	7	64 ^b	96 ^b
Hook & Line		136 ^c				177 ^d

^a Hours fished and rainbow trout captured by Alaska Department of Fish and Game employees only. It does not include hours fished and rainbow trout captured from the creel survey or by lodge owners.

^b Hours fished and rainbow trout captured by Alaska Department of Fish and Game employees and a lodge owner.

^c Total number of rainbow trout captured by hook and line (Alaska Department of Fish and Game employees, creel survey and lodge owners) but total sampling hours unknown.

^d Total number of rainbow trout captured by hook and line (Alaska Department of Fish and Game employees and a lodge owner) but total sampling hours unknown.

Table 2. Age composition of rainbow trout by gear type and in the sport harvest in Lake Creek, 1990.

Age Group	Hoop Trap			Minnow Trap			Hook and Line (ADFG Samples) ^a			Hook and Line (Creel Survey Samples) ^b		
	Percent	Sample Size	SE ^c	Percent	Sample Size	SE ^c	Percent	Sample Size	SE ^c	Percent	Sample Size	SE ^c
1				100.0	20	0.00						
2	29.8	106	2.43				20.5	16	4.60	9.5	4	4.58
3	36.2	129	2.55				41.0	32	5.61	21.4	9	6.41
4	21.1	75	2.16				21.8	17	4.70	26.2	11	6.87
5	11.5	41	1.69				10.3	8	3.46	31.0	13	7.22
6	1.1	4	0.56				3.8	3	2.19	9.5	4	4.58
7	0.3	1	0.28				2.6	2	1.80	2.4	1	2.38
Total	100.0	356		100.0	2		100.0	78		100.0	42	

^a Hook and line samples collected by Alaska Department of Fish and Game employees only.

^b Hook and line samples collected from anglers during the creel survey.

^c Standard Error.

χ^2 Test Ho: Age composition of rainbow trout captured by hoop traps = age composition of rainbow trout captured by hook and line (ADFG).

$$\chi^2 = 5.44 \quad df = 5 \quad 0.25 < p < 0.10$$

Table 3. Age composition of rainbow trout by gear type in the Deshka River, 1990.

Age Group	Hoop Trap			Hook and Line		
	Percent	Sample Size	SE ^a	Percent	Sample Size	SE ^a
1						
2	20.0	47	2.61			
3	34.5	81	3.11	57.1	4	20.20
4	32.3	76	3.06	28.6	2	18.44
5	11.1	26	2.05	14.3	1	14.29
6	2.1	5	0.94			
Total	100.0	235		100.0	7	

^a Standard Error

Table 4. Age composition of rainbow trout by gear type in the Talachulitna River, 1990.

Age Group	Hoop Trap			Minnow Trap			Hook and Line		
	Percent	Sample Size	SE ^a	Percent	Sample Size	SE ^a	Percent	Sample Size	SE ^a
1				100.0	3	0.00			
2	30.2	67	3.09				6.8	8	2.32
3	36.9	82	3.25				28.8	34	4.19
4	20.3	45	2.70				28.0	33	4.15
5	8.6	19	1.88				24.6	29	3.98
6	2.7	6	1.09				10.2	12	2.79
7	1.4	3	0.78				1.7	2	1.19
Total	100.0	222		100.0	3		100.0	118	

^a Standard Error

χ^2 Test Ho: Age composition of rainbow trout captured by hoop traps = the age composition of rainbow trout captured by hook and line.

$$\chi^2 = 44.78 \quad df = 5 \quad p < 0.001$$

Mean Length-at-Age:

Mean length-at-age varied by gear type and river (Table 5, 6, and 7).

At Lake Creek, the mean length-at-age of rainbow trout was compared between the hoop trap samples, hook and line (ADFG) samples, and hook and line (creel survey) samples. There were significant interactions between length-at-age and gear type ($P = 0.0122$). The mean length-at-age of rainbow trout was compared between the hoop trap samples and the hook and line samples from the Talachulitna River. There were significant interactions between length-at-age and gear type ($P = 0.0201$). Therefore, length-at-age data collected by the different gear types could not be combined in Lake Creek or the Talachulitna River.

At the Deshka River, there was an insufficient number of hook and line sampled rainbow trout to do a comparison for mean length-at-age with the hoop trap caught rainbow trout.

Length Distributions:

Rainbow trout sampled from Lake Creek (Figure 3) ranged in fork length from 151 mm to 505 mm for the hoop traps, from 155 mm to 565 mm for hook and line (ADFG), from 238 mm to 555 mm for hook and line (creel survey), and from 71 mm to 115 mm for the minnow traps.

The K-sample Anderson-Darling test comparing lengths of rainbow trout sampled at Lake Creek by hoop traps with the rainbow trout samples taken by hook and line (ADFG) and hook and line (creel survey) indicate that the length frequency is significantly different among the hoop trap samples and the two hook and line samples (ADFG and creel survey) (with $A^2_{akN} = 15.5249$, $\sigma^2_N = 1.1506$ and $T_{akN} = 12.850$ with the critical value of 1.945 for T_{akN}).

The K-sample Anderson-Darling test comparing lengths of rainbow trout sampled at Lake Creek by hoop traps with the rainbow trout samples taken by hook and line (ADFG) indicate that the length frequency is not significantly different between the two gear types (with $A^2_{akN} = 1.9857$, $\sigma^2_N = 0.5756$, and $T_{akN} = 1.336$ with the critical value of 1.960 for T_{akN}). When the hoop trap rainbow trout samples were combined with the hook and line (ADFG) samples the length frequency ranged from 151 mm to 565 mm with a mean of 298 mm (Figure 4).

Rainbow trout sampled from the Deshka River ranged in length from 183 mm to 473 mm for the hoop traps with a mean of 316 mm (Figure 5). The seven rainbow trout samples captured by hook and line ranged from 270 mm to 405 mm.

Rainbow trout sampled from the Talachulitna River ranged in length from 156 mm to 555 mm for the hoop traps, from 152 mm to 571 mm for hook and line, and from 121 mm to 150 mm for the minnow traps (Figure 6).

The K-sample Anderson-Darling test comparing lengths of rainbow trout sampled at the Talachulitna River by hoop traps with the rainbow trout samples taken by hook and line indicate that the length frequency is significantly different between the two gear types (with $A^2_{akN} = 45.8331$, $\sigma^2_N = 0.5745$ and $T_{akN} = 60.395$ with the critical value of 1.960 for T_{akN}).

Table 5. Mean fork length in millimeters by age group of rainbow trout by capture methods and in the sport harvest in Lake Creek, 1990.

Age Group	Hoop Trap			Minnow Trap			Hook and Line (ADFG Samples) ^a			Hook and line (Creel Survey Samples) ^b		
	Mean Length	Sample Size	SE ^c	Mean Length	Sample Size	SE ^c	Mean Length	Sample Size	SE ^c	Mean Length	Sample Size	SE ^c
1				94	20	2.3						
2	216	106	2.5				198	16	6.9	245	4	3.8
3	273	129	2.4				273	32	4.2	264	9	6.7
4	354	75	4.4				332	17	8.9	348	11	11.0
5	411	41	5.5				399	8	12.0	410	13	8.1
6	448	4	4.7				452	3	19.2	432	4	17.1
7	505	1					550	2	15.0	555	1	

^a Hook and line samples collected by Alaska Department of Fish and Game employees.

^b Hook and line samples collected from anglers during the creel survey.

^c Standard error.

Table 6. Mean fork length in millimeters by age group of rainbow trout by capture methods in the Deshka River, 1990.

Age Group	Hoop Trap			Hook and Line		
	Mean Length	Sample Size	SE ^a	Mean Length	Sample Size	SE ^a
1						
2	219	47	3.4			
3	293	81	3.6	316	4	15.6
4	355	76	2.8	332	2	2.0
5	411	26	4.2	405	1	
6	439	5	10.1			

^a Standard error.

Table 7. Mean fork length in millimeters by age group of rainbow trout by capture methods in the Talachulitna River, 1990.

Age Group	Hoop Trap			Minnow Trap			Hook and Line		
	Mean Length	Sample Size	SE ^a	Mean Length	Sample Size	SE ^a	Mean Length	Sample Size	SE ^a
1				132	3	8.9			
2	210	67	2.9				230	8	38.7
3	260	82	3.3				290	34	4.4
4	323	45	6.4				355	33	7.1
5	427	19	10.2				428	29	6.7
6	488	6	14.3				479	12	4.7
7	538	3	12.0				539	2	31.5

^a Standard error.

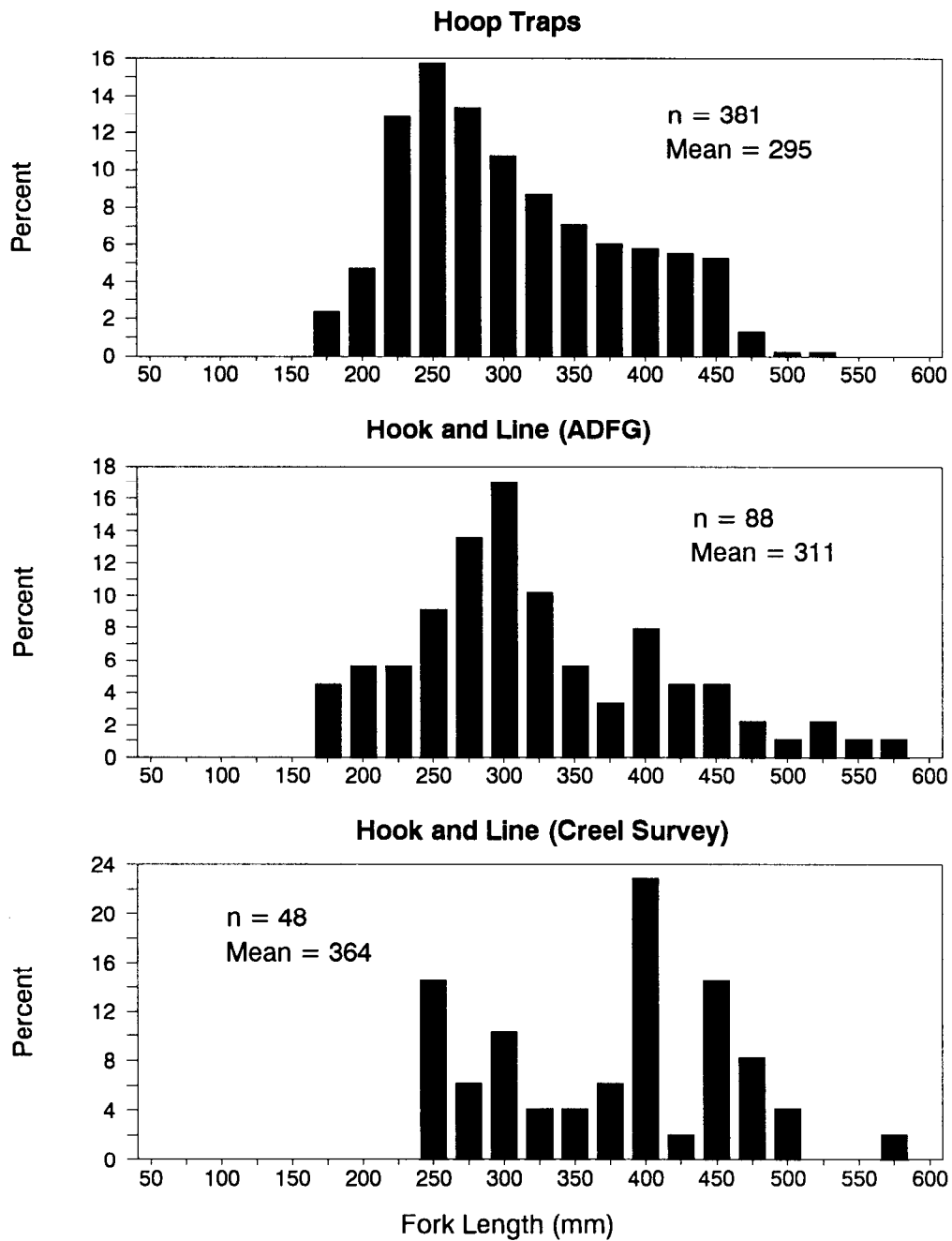


Figure 3. Length frequency distributions by gear type of rainbow trout captured in Lake Creek, 1990. Numbers on the x-scale are endpoints of each range.

Hoop Traps and Hook and Line (ADFG)

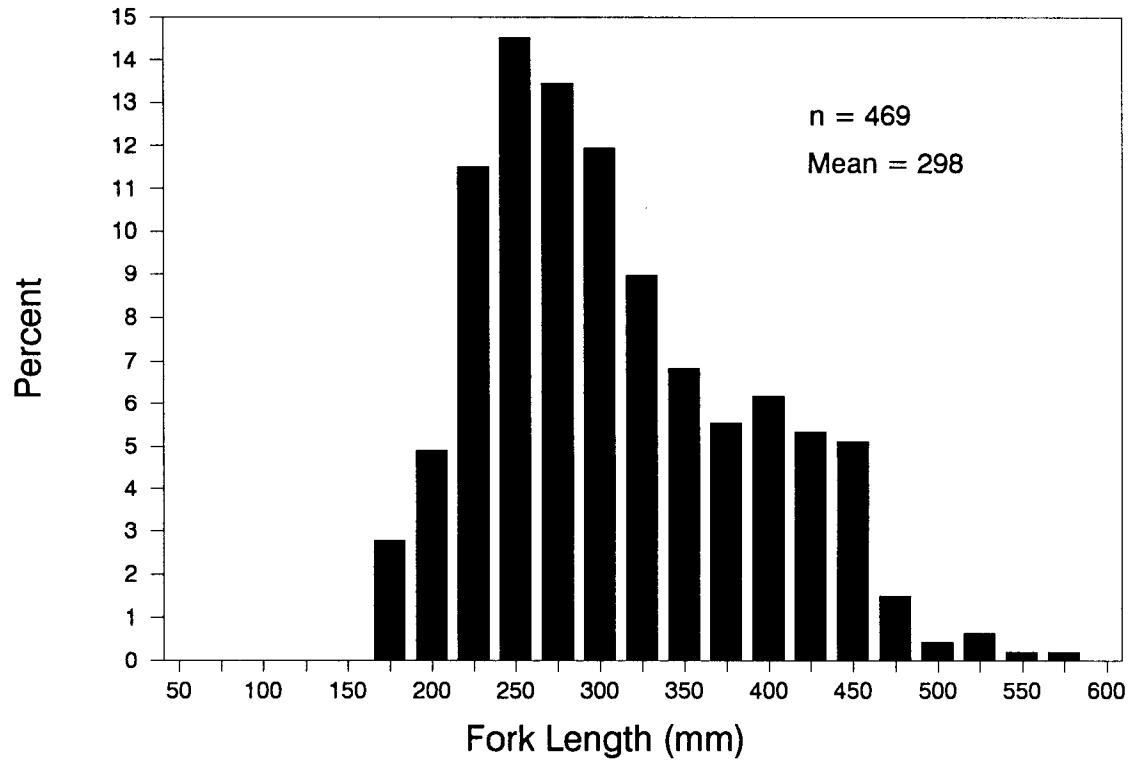


Figure 4. Length frequency distribution of rainbow trout captured with hoop traps and hook and line (ADFG) in Lake Creek, 1990. Numbers on the x-scale are endpoints of each range.

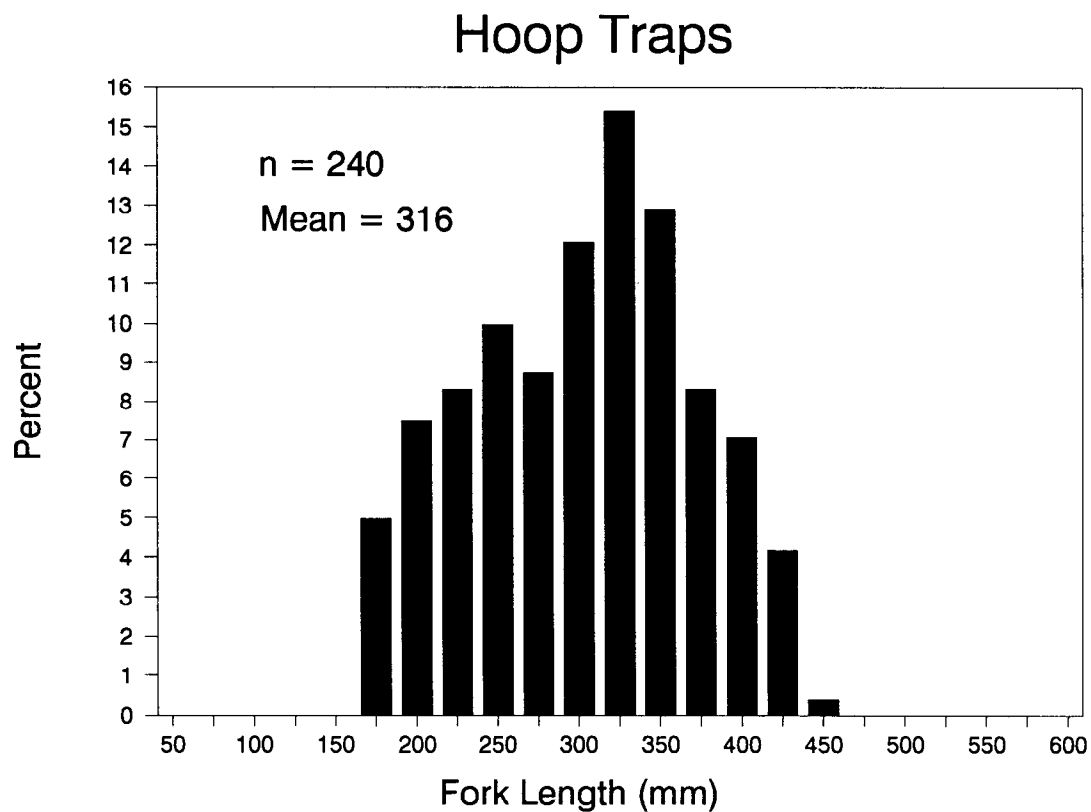


Figure 5. Length frequency distribution of rainbow trout captured by hoop traps in the Deshka River, 1990. Numbers on the x-scale are endpoints of each range.

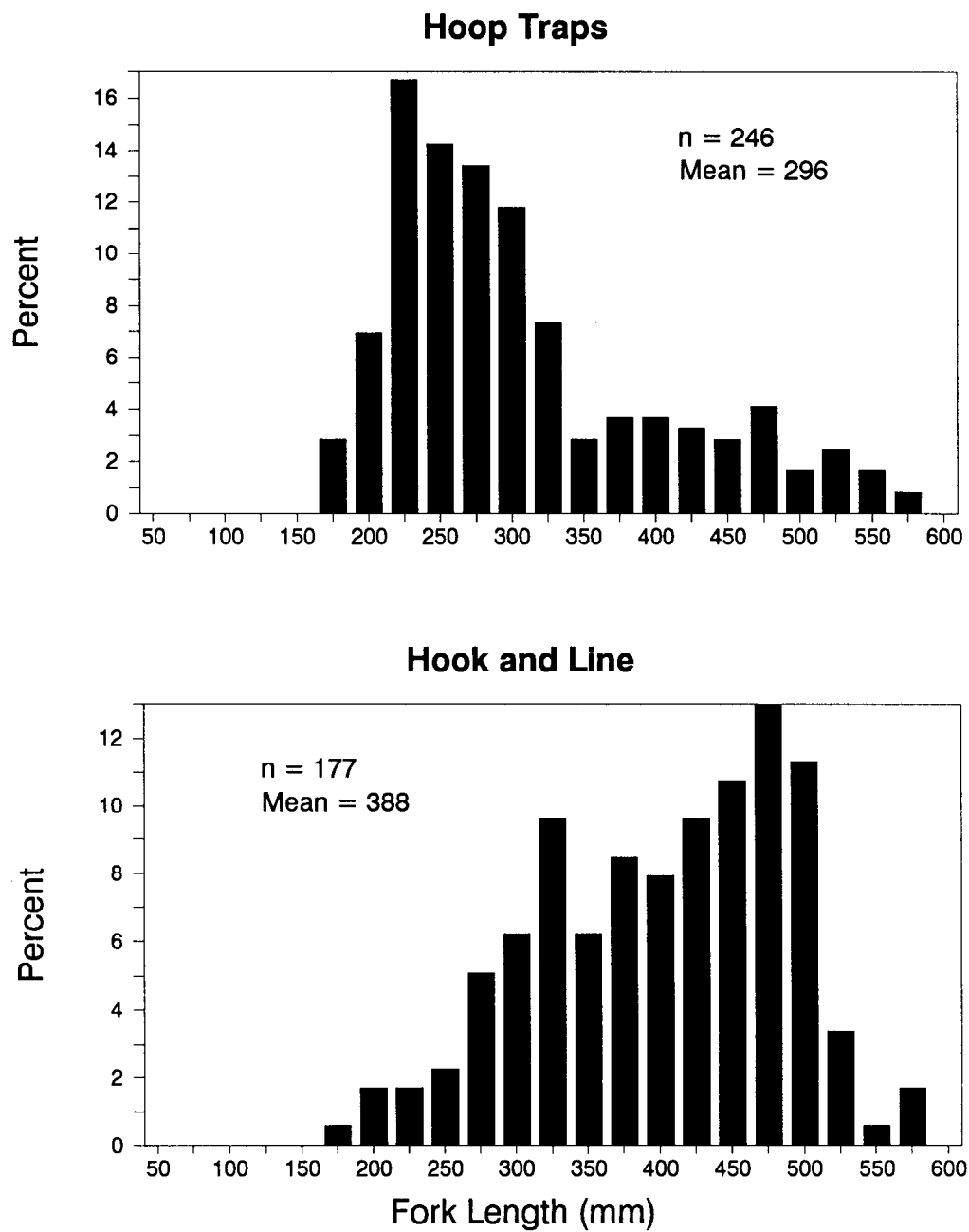


Figure 6. Length frequency distributions of rainbow trout captured in the Talachulitna River by gear type, 1990. Numbers on the x-scale are endpoints of each range.

Creel Estimates

Effort:

The Lake Creek creel survey was conducted from 12 August through 9 September. Two hundred and twenty-three (223) incomplete and 206 completed trip anglers were interviewed (Table 8). Mean angler counts ranged from 0 to 34 anglers per count (Appendix A1). Estimated angler-effort during the survey was 2,841 angler-hours (Table 9). River zones 1, 2, and 3 supported 24%, 66%, and 10% of this effort, respectively (Table 10).

Harvest and Catch:

There was a significant difference in the number of zero catches of rainbow trout between anglers who had completed their fishing trip and those who were still fishing when interviewed ($\chi^2 = 19.74$, $df = 1$, $p < 0.05$) (Table 11). Therefore, only complete-trip interviews were used in the estimation of catch and harvest of rainbow trout. Four strata were used for estimation of rainbow trout catch and harvest: a weekend and a weekday strata from 12 August to 26 August, and a weekend and a weekday strata from 27 August to 9 September.

The harvest rates remained low throughout the creel survey due to bag limit restrictions and angler preference to voluntarily release rainbow trout. Higher catch rates most frequently occurred from approximately 20 August on through the remainder of the creel survey. Harvest and catch rates of rainbow trout varied from 0.000 to 0.245 and 0.000 to 2.667 fish per hour, respectively (Appendix A1). The highest harvest rate and catch rate occurred on 27 August and 1 September, respectively.

The estimated catch of rainbow trout was 1,457 fish (SE = 213), of which 10% or 139 (SE = 41) were harvested (kept) by anglers (Table 9). All the rainbow trout harvested were caught in zone 2.

Miscellaneous Statistics:

Of the four questions asked anglers concerning artificial lures and mandatory release of rainbow trout, the majority of interviewed anglers for all temporal strata combined in zone 1 and 2 (the area open to harvest of rainbow trout) favored mandatory release of rainbow trout and the use of artificial lures (Table 12).

Bait and lure anglers comprised 2% of the interviewed angler trips for all temporal strata combined in zone 1 and 6% of the angler trips in zone 2. Lure anglers comprised 98% of the angler trips in zone 1 and 79% of the angler trips in zone 2 (Table 13). Only 10% of the interviewed anglers trips at Lake Creek used only bait as terminal gear.

Guided anglers accounted for approximately 90% of the observed angler trips during the creel survey for all strata combined (Table 8). Eighty-six percent of the interviewed angler trips were guided anglers, but only 49% of

Table 8. Summary of sample data for catch, harvest, and effort for anglers interviewed during the rainbow trout creel survey at Lake Creek, 1990.

Angler Type	Complete-trip Anglers				Incomplete-trip Anglers				All Anglers			
	Number of Anglers	Total Catch	Total Harvest	Total Effort	Number of Anglers	Total Catch	Total Harvest	Total Effort	Number of Anglers	Total Catch	Total Harvest	Total Effort
Guided	179	554	25	925.25	188	224	20	479.25	367	778	45	1404.50
Unguided	27	55	2	88.25	35	27	4	60.50	62	82	6	148.75
Both	206	609	27	1013.50	223	251	24	539.75	429	860	51	1553.25

Table 9. Estimated effort, catch, and harvest for the Lake Creek rainbow trout creel survey, 1990.

	Stratum ^a	Number of days		Mean	Total	S1h ²	Variance Components			Total Variance	RP ^b
		Total	Sampled				Stage 1	Stage 2	Stage 3		
Effort	1	5	5	165	824	19,363	0	46,464	6,682	53,146	55
	2	10	6	84	840	1,952	13,013	3,264	1,984	18,261	31
	3	5	5	83	413	6,459	0	3,778	1,058	4,836	33
	4	9	4	85	764	967	10,876	13,908	2,679	27,463	42
Total					2,841					103,706	22
Rainbow Trout	1	5	4	58	288	3,856	0	5,937	408	6,345	54
Catch	2	10	6	41	406	1,122	7,482	7,143	1,197	15,822	61
	3	5	5	78	388	11,167	0	10,563	1,936	12,499	56
	4	9	4	42	375	563	6,338	979	3,198	10,516	54
Total					1,457					45,182	29
Rainbow Trout	1	5	4	7	35	123	0	302	125	427	116
Harvest	2	10	5	5	54	70	464	65	49	578	87
	3	5	5	1	4	2	0	0	2	2	69
	4	9	4	5	46	50	559	1	93	652	109
Total					139					1,659	57

^a Strata: 1 = 12 August - 26 August, weekends,
2 = 12 August - 26 August, weekdays,
3 = 27 August - 9 September, weekends,
4 = 27 August - 9 September, weekdays.

^b Relative precision of 95% confidence interval.

Table 10. Estimated effort by zone for the Lake Creek rainbow trout creel survey, 1990.

	Stratum ^a	Number of days		Mean	Total	S1h ²	Variance Components			Total Variance	RP ^b
		Total	Sampled				Stage 1	Stage 2	Stage 3		
Zone 1	1	2 ^c	2	118	236	16,200	0	6,000	416	6,416	67
	2	0 ^c	0								
	3	5	5	34	168	1,284	0	794	186	980	37
	4	9	4	31	283	670	7,534	2,977	595	11,106	73
	Total				687					18,502	39
Zone 2	1	5	5	107	536	10,139	0	20,218	3,072	23,290	56
	2	10	6	73	733	1,988	13,255	2,656	1,685	17,596	35
	3	5	5	39	193	2,070	0	889	887	1,776	43
	4	9	4	45	402	346	3,893	3,622	717	8,232	44
	Total				1,864					50,894	24
Zone 3	1	5	5	10	52	109	0	586	390	976	118
	2	10	6	11	107	305	2,034	416	192	2,642	94
	3	5	5	11	53	98	0	184	250	434	77
	4	9	4	9	79	37	413	298	287	998	78
	Total				291					5,050	48

^a Strata: 1 = 12 August - 26 August, weekends,
2 = 12 August - 26 August, weekdays,
3 = 27 August - 9 September, weekends,
4 = 27 August - 9 September, weekdays.

^b Relative precision of 95% confidence interval.

^c Creel survey did not start in zone 1 until 25 August because of the coho salmon fishery in the area and the absence of anglers targeting on rainbow trout.

Table 11. Composition of anglers with 1 or more rainbow trout and anglers with no rainbow trout for complete/incomplete and guided/unguided angler interviews during the rainbow trout creel survey at Lake Creek, 1990.

Interview	Number of Rainbow Trout	Guided Interviews		Unguided interviews	
		Number	Percent	Number	Percent
Complete-trip	≥1	117	65	14	52
Complete-trip	=0	62	35	13	48
Incomplete-trip	≥1	83	44	11	31
Incomplete-trip	=0	105	56	24	69

χ^2 test H_0 : Percent of complete-trip guided anglers with zero catch = percent of incomplete-trip guided anglers with zero catch.

$$\chi^2 = 16.64, df = 1, p < 0.001$$

χ^2 test H_0 : Percent of complete-trip unguided anglers with zero catch = percent of incomplete-trip unguided anglers with zero catch.

$$\chi^2 = 2.64, df = 1, 0.10 < p < 0.25$$

χ^2 Test H_0 : Percent of all complete anglers with zero catch = percent of all incomplete anglers with zero catch.

$$\chi^2 = 19.74 \quad df = 1 \quad p < 0.05$$

Table 12. Opinions from interviewed angler trips during the creel survey for rainbow trout at Lake Creek, 1990.

Most of the Lake Creek drainage is now governed by regulations that require or promote the release of rainbow trout.

A. Should these artificial lure/no kill requirements be expanded, eliminated or left as is within the Lake Creek drainage?

Zone 1 and 2							Zone 3						
WE/WD	Expanded		Eliminated		Left as is		WE/WD	Expanded		Eliminated		Left as is	
	n	Percent	n	Percent	n	Percent		n	Percent	n	Percent	n	Percent
Weekend	90	37	6	3	60	25	Weekend	22	69	0	0	1	3
Weekday	44	18	6	3	34	14	Weekday	8	25	0	0	1	3

B. Do you favor, oppose or have no opinion on requiring mandatory release of rainbow trout at other Susitna basin waters?

Zone 1 and 2							Zone 3						
WE/WD	Favor		Oppose		No opinion		WE/WD	Favor		Oppose		No opinion	
	n	Percent	n	Percent	n	Percent		n	Percent	n	Percent	n	Percent
Weekend	111	46	14	6	31	13	Weekend	23	72	0	0	0	0
Weekday	53	22	9	4	22	9	Weekday	9	28	0	0	0	0

The use of unbaited artificial lures is now required on the lower 2-1/2 miles of Lake Creek after September 1.

A. Do you favor, oppose or have no opinion on this artificial lure requirement?

Zone 1 and 2							Zone 3						
WE/WD	Favor		Oppose		No opinion		WE/WD	Favor		Oppose		No opinion	
	n	Percent	n	Percent	n	Percent		n	Percent	n	Percent	n	Percent
Weekend	95	40	10	4	51	21	Weekend	20	63	2	6	1	3
Weekday	40	17	7	3	37	15	Weekday	9	28	0	0	0	0

-continued-

Table 12. (Page 2 of 2).

B. Should this artificial lure requirement start earlier in the season, start later in the season or be left as is?

Zone 1 and 2							Zone 3						
WE/WD	Earlier		Later		Left as is		WE/WD	Earlier		Later		Left as is	
	n	Percent	n	Percent	n	Percent		n	Percent	n	Percent	n	Percent
Weekend	95	40	10	4	51	21	Weekend	20	63	2	6	1	3
Weekday	40	17	7	3	37	15	Weekday	9	28	0	0	0	0

Table 13. Composition of interviewed angler trips by zone using bait, lures, or both bait and lures during the rainbow trout creel survey at Lake Creek, 1990.

Gear	Number of Anglers							
	Zone 1		Zone 2		Zone 3		Zone 1-3	
Bait	0	(0%)	43	(15%)	0	(0%)	43	(10%)
Lures	82	(98%)	232	(79%)	53	(100%)	367	(86%)
Both ^a	2	(2%)	17	(6%)	0	(0%)	19	(4%)
Total	84	(100%)	292	(100%)	53	(100%)	429	(100%)

^a Bait and lures.

these anglers had a guide physically present with them while fishing (Table 14). Of the guided angler trips, 51% were dropped off by either a charter boat or air taxi operator.

DISCUSSION

The rainbow trout sampling at Lake Creek and the Talachulitna River was concentrated within the lower several miles of river while at the Deshka River the sampling was scattered from the confluence with the Susitna River to the Neil Lake area, a distance of approximately 32 km (20 mi), and a 13 km (8 mi) section of Moose Creek south of the Petersville Road. Sampling took place at Lake Creek in August, at the Deshka River in September and October, and at the Talachulitna River in July.

The hoop trap and hook and line catch rates were considerably lower at the Deshka River than they were at Lake Creek and the Talachulitna River. The Deshka River rainbow trout were not as concentrated as they were at Lake Creek or the Talachulitna River and tended to be scattered throughout the area trapped as the hoop trap catches at times produced only one or two rainbow trout per trap and sometimes no rainbow trout.

The hoop traps, covered with 2.5 cm (1 in) mesh, captured rainbow trout from approximately 160 mm to 550 mm in fork length. It appeared that rainbow trout larger than approximately 500 mm in fork length were not fully recruited to the hoop traps as only a few were captured. The throat of the hoop traps was of sufficient size to catch larger fish because on occasion chum salmon *Oncorhynchus keta* were captured. Rainbow trout smaller than 150 mm to 175 mm in fork length were not contained by the hoop traps as the mesh size was too large to prevent the fish from passing through the mesh, but on occasion they gilled themselves in the mesh. Using hoop traps covered with 2 cm (3/4 in mesh) would capture rainbow trout 140 mm to 175 mm in fork length, which are probably the smaller age-2 rainbow trout.

For hoop trap catches, the Deshka River was the only river in which a rainbow trout did not exceed 500 mm in fork length, the largest being 473 mm. The Talachulitna River had more rainbow trout over 500 mm in fork length than either Lake Creek or the Deshka River.

Overall, at Lake Creek, the hook and line (creel survey) sampled rainbow trout were larger than the hook and line (ADFG) sampled rainbow trout. With a limit of only two rainbow trout per day, anglers tended to release smaller fish in the hope of harvesting a larger rainbow trout. The anglers sampling for the ADFG hook and line sample recorded all fish caught regardless of size.

At Lake Creek in the latter part of August, during the peak of the chum salmon spawning, the catch rates for rainbow trout increased for both the hoop trap and hook and line methods of capture. At this time, the rainbow trout were concentrated near the chum salmon spawning areas and were vulnerable to easier capture by both the angler and the hoop trap.

Table 14. Composition of guided and unguided anglers in interviewed angler trips during the rainbow trout creel survey at Lake Creek, 1990.

Type of Angler	Number of Anglers	Percent of Anglers	Type of Guided Angler	Number of Anglers	Percent of Guided Anglers
Guided	367	86	Guide present	178	49
Unguided	62	14	Charter/dropoff ^a	189	51
Total	429	100	Total	367	100

^a Angler fishing without a guide present.

The two previous (1988 and 1989) Lake Creek fall creel surveys targeted coho salmon anglers more so than rainbow trout anglers (Hepler and Vincent-Lang 1989, Bradley 1990). This was due to the majority of anglers fishing for coho salmon and the creel census personnel randomly interviewing anglers during the interview periods. In 1990, the coho salmon congregated at the confluence area longer than previous years, probably due to the low water conditions in Lake Creek, and once they started migrating upstream they moved rapidly through the lower 4.8 to 6.5 km (3 to 4 mi) of river. Because of the congregation of anglers targeting coho salmon at the mouth of Lake Creek and few rainbow trout being caught in zone 1 early in the creel survey, interviewing and angler counts did not begin in zone 1 until 25 August. By then the majority of coho salmon had migrated upstream and the catch rate of rainbow trout had increased.

The angler effort in 1990 (2,841 angler-hours) was considerably lower than in either 1988 or 1989 (11,117 and 7,411 angler-hours respectively) (Hepler and Vincent-Lang 1989, Bradley 1990). Effort, harvest, and catch of rainbow trout were lower in 1989 than 1990 due to the inclement weather and high, muddy stream conditions during most of the creel survey in 1989.

Rainbow trout catch rates peaked in late August to early September. This was due in part to the rainbow migrating to zone 2 and the lower end of zone 3 to feed on eggs from the spawning chum salmon.

While somewhat ambiguous, results of the angler survey tended to support special management regulations for rainbow trout. A greater percentage of surveyed anglers in 1990 preferred mandatory release of rainbow trout and the use of artificial lures than those surveyed in 1989 (Bradley 1990).

ACKNOWLEDGEMENTS

The author would like to thank the following people who assisted with the project: Jackie Kephart conducted the creel survey, assisted in the biological collections and mounted the scales; Larry Engel, Al Havens, Bob Begich, Craig Baer, Dana Sweet, Jim Ball, Dave Rutz and Jim Whitt assisted and cooperated in various aspects of the project, and Marianna Alexandersdottir and Sandra Sonnichsen assisted in data analysis. Special thanks go to Ed and Judy Sharp of Wilderness Place Lodge at Lake Creek and Steve and Louise Johnson of Talaview Lodge at the Talachulitna River for their friendly cooperation, housing, and scale collection over the years.

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APPENDIX A

Appendix A1. Daily statistics by period for the Lake Creek rainbow trout creel survey, 1990.

Date	WE/ WD ^a	Period ^b	Mean Count	Total Effort ^c	VAR ^d Effort	Numb Int ^e	CPUE ^f	VAR CPUE	Total Catch	VAR Catch	HPUE ^g	VAR HPUE	Harvest	VAR Harvest
900812	WE	2	29.0	93	92	4	0.142	0.003	13	28	0.000	0.000	0	0
900812	WE	5	8.0	26	0	4	0.111	0.012	3	8	0.000	0.000	0	0
900813	WD	2	10.5	34	23	3	0.476	0.002	16	8	0.000	0.000	0	0
900813	WD	5	6.0	19	10	0								
900816	WD	4	6.5	21	125	5	0.981	0.168	20	172	0.155	0.004	3	4
900816	WD	5	4.5	14	3	2	0.188	0.004	3	1	0.000	0.000	0	0
900817	WD	4	7.5	24	23	10	0.117	0.005	3	3	0.000	0.000	0	0
900817	WD	5	5.0	16	92	0								
900818	WE	2	1.0	3	10	0								
900818	WE	4	7.5	24	64	20	0.287	0.009	7	10	0.014	0.000	0	0
900819	WE	4	4.5	14	125	5	0.060	0.003	1	1	0.000	0.000	0	0
900819	WE	5	8.0	26	10	2	0.083	0.007	2	5	0.042	0.002	1	1
900820	WD	3	5.5	18	64	3	0.000	0.000	0	0	0.000	0.000	0	0
900820	WD	4	6.0	19	0	2	1.500	0.028	29	10	0.000	0.000	0	0
900821	WD	3	8.0	26	10	3	0.148	0.005	4	4	0.148	0.005	4	4
900821	WD	4	3.5	11	125	4	0.375	0.006	4	18	0.000	0.000	0	0
900822	WD	1	0.0	0	0	0								
900822	WD	5	0.0	0	0	3	0.857	0.027	0	0	0.000	0.000	0	0
900825	WE	2	34.0	109	2,304	16	0.096	0.002	10	40	0.084	0.002	9	34
900825	WE	5	7.5	24	3	22	2.036	0.021	49	23	0.010	0.000	0	0
900826	WE	1	3.5	11	64	0								
900826	WE	5	0.0	0	0	15	0.695	0.039	0	0	0.000	0.000	0	0
900827	WD	3	11.5	32	96	9	0.348	0.014	11	25	0.089	0.001	3	2
900827	WD	4	2.5	7	49	6	2.644	0.140	19	343	0.245	0.002	2	3
900828	WD	4	12.5	35	2	0								
900828	WD	5	5.0	14	196	12	0.422	0.031	6	35	0.067	0.002	1	1
900901	WE	3	10.5	29	49	1	2.667	0.000	78	348	0.000	0.000	0	0
900901	WE	4	14.0	39	8	16	0.648	0.032	25	52	0.000	0.000	0	0
900902	WE	2	3.0	8	31	0								
900902	WE	5	6.5	18	2	11	0.706	0.019	13	7	0.035	0.000	1	0
900903	WE	2	6.5	18	331	0								
900903	WE	3	16.5	46	2	2	0.250	0.063	12	133	0.000	0.000	0	0

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Appendix A1. (Page 2 of 2).

Date	WE/ WD ^a	Period ^b	Mean Count	Total Effort ^c	VAR ^d Effort	Numb Int ^e	CPUE ^f	VAR CPUE	Total Catch	VAR Catch	HPUE ^g	VAR HPUE	Harvest	VAR Harvest
900904	WD	3	3.0	8	8	0								
900904	WD	4	6.0	17	0	4	0.513	0.019	9	5	0.000	0.000	0	0
900905	WD	1	0.0	0	0	0								
900905	WD	5	8.0	22	125	18	0.353	0.007	8	18	0.000	0.000	0	0
900908	WE	1	0.0	0	0	0								
900908	WE	5	2.0	6	0	2	0.500	0.028	3	1	0.000	0.000	0	0
900909	WE	2	0.0	0	0	2	2.083	0.174	0	0	0.000	0.000	0	0
900909	WE	4	0.0	0	0	0								

^a WE = Weekend
WD = Weekday.

^b

	<u>12 May - 26 August</u>	<u>27 August - 9 September</u>
Period 1 =	0600 - 0912	0600 - 0848
Period 2 =	0913 - 1224	0849 - 1136
Period 3 =	1225 - 1536	1137 - 1424
Period 4 =	1537 - 1848	1425 - 1712
Period 5 =	1849 - 2200	1713 - 2000

^c Angler-hours.

^d Variance.

^e Number of interviews.

^f Catch per angler-hour.

^g Harvest per angler-hour.

Appendix A2. Daily statistics for effort, catch, and harvest for the Lake Creek rainbow trout creel survey, 1990.

Date	Effort				Catch				Harvest			
	Periods ^a	Mean	Variance	Total	Periods ^a	Mean	Variance	Total	Periods ^a	Mean	Variance	Total
900812	2	59.2	2257.92	296.0	2	7.9884	52.92	39.942	2	0.00000	0.0000	0.0000
900813	2	26.4	103.68	132.0	1	16.0000	0.00	80.000	0			
900816	2	17.6	20.48	88.0	2	11.5506	156.67	57.753	2	1.60707	5.1653	8.0353
900817	2	20.0	32.00	100.0	1	2.8072	0.00	14.036	1	0.00000	0.0000	0.0000
900818	2	13.6	216.32	68.0	1	6.8945	0.00	34.472	1	0.33176	0.0000	1.6588
900819	2	20.0	62.72	100.0	2	1.5003	0.80	7.501	2	0.53333	0.5689	2.6667
900820	2	18.4	1.28	92.0	2	14.4000	414.72	72.000	2	0.00000	0.0000	0.0000
900821	2	18.4	103.68	92.0	2	3.9963	0.08	19.981	1	3.79259	0.0000	18.9630
900822	2	0.0	0.00	0.0	1	0.0000	0.00	0.000	2	0.00000	0.0000	0.0000
900825	2	66.4	3595.52	332.0	2	29.6444	737.94	148.222	2	4.70541	39.6924	23.5271
900826	2	5.6	62.72	28.0	0				0			
900827	2	19.6	317.52	98.0	2	14.8515	26.77	74.258	2	2.98789	0.0304	14.9394
900828	2	24.5	220.50	122.0	1	5.9136	0.00	29.568	1	1.09940	0.0000	5.4970
900901	2	34.3	48.02	171.5	2	51.9005	1404.45	259.502	2	0.00000	0.0000	0.0000
900902	2	13.3	48.02	66.5	1	12.8487	0.00	64.244	1	0.70389	0.0000	3.5195
900903	2	32.2	392.00	161.0	1	11.5500	0.00	57.750	1	0.00000	0.0000	0.0000
900904	2	12.6	35.28	63.0	1	8.6250	0.00	43.125	1	0.00000	0.0000	0.0000
900905	2	11.2	250.88	56.0	2	3.9534	31.26	19.767	2	0.00000	0.0000	0.0000
900908	2	2.8	15.68	14.0	2	1.4000	3.92	7.000	2	0.00000	0.0000	0.0000
900909	2	0.0	0.00	0.0	1	0.0000	0.00	0.000	1	0.00000	0.0000	0.0000

^a Number of periods sampled.

Appendix A3. Daily statistics for effort by period and zone for the Lake Creek rainbow trout creel survey, 1990.

Date	WE/WD ^a	Period ^b	Zone 1			Zone 2			Zone 3		
			Mean Count	Total Effort ^c	Variance Effort	Mean Count	Total Effort ^c	Variance Effort	Mean Count	Total Effort ^c	Variance Effort
900812	WE	2				26.0	83.2	0.0	3.0	9.6	92.2
900812	WE	5				8.0	25.6	0.0	0.0	0.0	0.0
900813	WD	2				10.0	32.0	41.0	0.5	1.6	2.6
900813	WD	5				6.0	19.2	10.2	0.0	0.0	0.0
900816	WD	4				6.5	20.8	125.4	0.0	0.0	0.0
900816	WD	5				4.5	14.4	2.6	0.0	0.0	0.0
900817	WD	4				7.5	24.0	23.0	0.0	0.0	0.0
900817	WD	5				5.0	16.0	92.2	0.0	0.0	0.0
900818	WE	2				1.0	3.2	10.2	0.0	0.0	0.0
900818	WE	4				7.5	24.0	64.0	0.0	0.0	0.0
900819	WE	4				4.5	14.4	125.4	0.0	0.0	0.0
900819	WE	5				6.5	20.8	2.6	1.5	4.8	23.0
900820	WD	3				3.5	11.2	64.0	2.0	6.4	0.0
900820	WD	4				6.0	19.2	0.0	0.0	0.0	0.0
900821	WD	3				4.5	14.4	23.0	3.5	11.2	2.6
900821	WD	4				1.5	4.8	23.0	2.0	6.4	41.0
900822	WD	1				0.0	0.0	0.0	0.0	0.0	0.0
900822	WD	5				0.0	0.0	0.0	0.0	0.0	0.0
900825	WE	2	19.0	60.8	92.2	13.0	41.6	1024	2.0	6.4	41.0
900825	WE	5	7.0	22.4	10.2	0.5	1.6	2.6	0.0	0.0	0.0
900826	WE	1	3.5	11.2	64.0	0.0	0.0	0.0	0.0	0.0	0.0
900826	WE	5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
900827	WD	3	5.0	14.0	7.8	5.5	15.4	17.6	1.0	2.8	7.8
900827	WD	4	0.0	0.0	0.0	1.5	4.2	17.6	1.0	2.8	7.8
900828	WD	4	5.5	15.4	2.0	7.0	19.6	0.0	0.0	0.0	0.0
900828	WD	5	3.5	9.8	96.0	1.5	4.2	17.6	0.0	0.0	0.0
900901	WE	3	6.0	16.8	0.0	4.5	12.6	49.0	0.0	0.0	0.0
900901	WE	4	7.0	19.6	7.8	5.0	14.0	0.0	2.0	5.6	31.4
900902	WE	2	2.5	7.0	49.0	0.0	0.0	0.0	0.5	1.4	2.0
900902	WE	5	2.5	7.0	2.0	2.0	5.6	31.4	2.0	5.6	31.4
900903	WE	2	0.0	0.0	0.0	5.0	14.0	196.0	1.5	4.2	17.6
900903	WE	3	5.0	14.0	7.8	10.0	28.0	70.6	1.5	4.2	17.6

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Appendix A3. (Page 2 of 2).

Date	WE/WD ^a	Period ^b	Zone 1			Zone 2			Zone 3		
			Mean Count	Total Effort ^c	Variance Effort	Mean Count	Total Effort ^c	Variance Effort	Mean Count	Total Effort ^c	Variance Effort
900904	WD	3	0.0	0.0	0.0	3.0	8.4	7.8	0.0	0.0	0.0
900904	WD	4	0.0	0.0	0.0	4.5	12.6	17.6	1.5	4.2	17.6
900905	WD	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
900905	WD	5	4.0	11.2	0.0	2.5	7.0	49.0	1.5	4.2	17.6
900908	WE	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
900908	WE	5	1.0	2.8	7.8	1.0	2.8	7.8	0.0	0.0	0.0
900909	WE	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
900909	WE	4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

^a WE = Weekend
WD = Weekday.

^b

	<u>12 May - 26 August</u>	<u>27 August - 9 September</u>
Period 1 =	0600 - 0912	0600 - 0848
Period 2 =	0913 - 1224	0849 - 1136
Period 3 =	1225 - 1536	1137 - 1424
Period 4 =	1537 - 1848	1425 - 1712
Period 5 =	1849 - 2200	1713 - 2000

^c Angler-hours.

Appendix A4. Daily statistics for effort by zone for the Lake Creek rainbow trout creel survey, 1990.

Date	Zone 1				Zone 2				Zone 3			
	Periods ^a	Mean	Variance	Total	Periods ^a	Mean	Variance	Total	Periods ^a	Mean	Variance	Total
900812	0				2	54.4	1658.88	272.0	2	4.8	46.08	24.0
900813	0				2	25.6	81.92	128.0	2	0.8	1.28	4.0
900816	0				2	17.6	20.48	88.0	2	0.0	0.00	0.0
900817	0				2	20.0	32.00	100.0	2	0.0	0.00	0.0
900818	0				2	13.6	216.32	68.0	2	0.0	0.00	0.0
900819	0				2	17.6	20.48	88.0	2	2.4	11.52	12.0
900820	0				2	15.2	32.00	76.0	2	3.2	20.48	16.0
900821	0				2	9.6	46.08	48.0	2	8.8	11.52	44.0
900822	0				2	0.0	0.00	0.0	2	0.0	0.00	0.0
900825	2	41.6	737.28	208	2	21.6	800.00	108.0	2	3.2	20.48	16.0
900826	2	5.6	62.72	28	2	0.0	0.00	0.0	2	0.0	0.00	0.0
900827	2	7.0	98.00	35	2	9.8	62.72	49.0	2	2.8	0.00	14.0
900828	2	12.6	15.68	63	2	11.9	118.58	59.5	2	0.0	0.00	0.0
900901	2	18.2	3.92	91	2	13.3	0.98	66.5	2	2.8	15.68	14.0
900902	2	7.0	0.00	35	2	2.8	15.68	14.0	2	3.5	8.82	17.5
900903	2	7.0	98.00	35	2	21.0	98.00	105.0	2	4.2	0.00	21.0
900904	2	0.0	0.00	0	2	10.5	8.82	52.5	2	2.1	8.82	10.5
900905	2	5.6	62.72	28	2	3.5	24.50	17.5	2	2.1	8.82	10.5
900908	2	1.4	3.92	7	2	1.4	3.92	7.0	2	0.0	0.00	0.0
900909	2	0.0	0.00	0	2	0.0	0.00	0.0	2	0.0	0.00	0.0

^a Number of periods sampled.